

General Physics

A TOOL FOR MEASURING THE SPECTRAL SENSITIVITY OF THE HUMAN EYE

Kendra E Rand and Ann J Randolph

Carthage College
2001 Alford Park Drive
Kenosha, WI 53140
kcrosby@carthage.edu
Kevin Crosby*

This past summer we had the chance to work for the Center for Adaptive Optics, a National Science Foundation funded Science and Technology Center. Our goal for this past summer was to develop museum demonstrations that illustrate how optical and adaptive optics systems work.

In this talk we will describe the design and demonstrate the operation of a device that allows an individual to directly observe the spectral sensitivity of his or her eyes. The demonstration is based on a slit light source where the light intensity drops rapidly from one end of the slit to the other end. By viewing the slit through a diffraction grating, an observer sees a spectrum whose height is proportional to the apparent intensity at each wavelength. Since the halogen light source used has a relatively flat spectrum over the visible range, the apparent height of the spectrum is due to the variation in the color sensitivity of the human eye. One of the significant accomplishments was developing the slit system, which incorporates a graded density filter and a complex slit profile to achieve the necessary intensity variation.

When we started this project we expected to see the spectral sensitivity of the human eye follow a simple, single-maximum profile as represented in textbooks. Instead we found within the broad distribution a profile with three peaks centered in the red, blue, and green. The system that we built was sufficiently sensitive for users to see this effect which is due to the fact that the human eye has three different types of cones which are sensitive to red, blue, and green light.

In addition to variations among individual users, we have also observed differences in spectral response apparently due to age of observer and degree of color-blindness. We have also used this device to exhibit the spectral response of the dark-adapted eye. This demonstration allows users to observe that the rods, which are not used for color vision, do peak in the yellow green light, and exhibit a different spectral response than the cones.

To our knowledge, the spectral sensitivity of the human eye has not been demonstrated in such a visual way. This system could be easily reproduced and incorporated into educational environments and museums.